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ABSTRACT

Noticing relationships between similar things and developing rules for treating things the same or differently, based on characteristics like color, size, shape, and texture provides the basis of beginning mathematics learning. Based on the view that teachers and parents of young children should provide children with age-appropriate words, materials, and experiences so they can investigate math concepts with adult support and encouragement, this booklet with accompanying videotape describes the 13 math-related key experiences of the High/Scope model grouped under classification, seriation, and number. The booklet provides lists of materials that promote math exploration and descriptions of teaching strategies that will help adults recognize and make the most of math opportunities throughout the day. Included in the booklet are pictures and anecdotal examples of children participating in the math-related key experiences. The booklet concludes with a list of materials and a strategies checklist. Each of the 13 key experiences are introduced in the accompanying 60-minute videotape, illustrated with sequences of children and teachers in a variety of High/Scope classrooms. The second part of the videotape shows four extended video scenes from High/Scope classrooms, presented without narration as in-depth examples of how the math-related key experiences naturally unfold; adults are shown responding to children's play ideas and following children's cues and interests as they help them carry out and develop their ideas. A viewer guide to the video describes the components of the video; provides a strategies checklist for classification, seriation, and number key experiences; and lists five additional resources from High/Scope. (KB)

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Early Math

High/Scope

PRESCHOOL Key Experiences

Classification, Seriation, and Number

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High/Scope Educational Research Foundation. (2003). *Classification, seriation, and number* [videotape].

Hohmann, M. (2002). *A study guide to educating young children: Exercises for adult learners* (2nd ed.).

Hohmann, M. & Weikart, D.P. (2002). *Educating young children: Active learning practices for preschool and child care programs* (2nd ed.).

Vogel, N. (2001). Young children and mathematics. *You & Your Child* [Parent information series of newsletters].

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Math-Related Key Experiences

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☆ Sorting and matching **page 12**

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How do young children learn math?

Young children are ***active* learners** who learn math concepts by pursuing their own interests while being actively supported and challenged by adults. As children wonder about what things are like and how things work, their curiosity leads them to explore their environment in search of answers. At the same time, their emerging ability to form mental images helps them to notice relationships between similar things and to develop rules for treating things the same or differently, based on characteristics like color, size, shape, and texture.

Young children are also ***concrete* thinkers.** In contrast to adults and older children who can use abstract methods such as paper-and-pencil arithmetic or mental calculations to solve math problems, young children first need to see objects and physically work with them before coming to their mathematical conclusions.

Children in early childhood vary widely in their ability to understand quantity, number, and other math concepts. Because of this variability in understanding, two children may reach the same mathematical conclusion in very different ways. Jess, for example, sorts a large pile of blocks into one pile of squares, one pile of rectangles, and one pile of triangles **to see which pile is biggest.** After separating the blocks in the same way, John also lines up each pile of blocks end to end **to see which line is the longest.** Jess and John will probably reach the same conclusion, but by different pathways to understanding.

Hands-on exploration encourages math learning

What are High/Scope's thoughts on teaching math to young children?

Educators have long debated about when and how to introduce mathematics to young children. Some educators and parents believe that preschoolers are too young for math in any form. Others believe they should be taught counting and basic arithmetic before beginning elementary school. **High/Scope takes a balanced position in this ongoing debate and is involved in discussions with leading experts in the field.**

Young children are naturally curious about math and need to hear math-related language and have math-related experiences throughout the day. Our job as teachers and parents is to provide them with the words, materials, and experiences appropriate for math learning at their age so they can investigate size, quantity, categorization, patterns, space, speed, and sequence on their own terms with our support and encouragement.

How can I support math learning when I'm not good at math?

Many teachers and parents have unpleasant memories of struggling to learn the multiplication table, complete math work sheets, and understand algebra or geometry during their school years. Because of these experiences, some of us don't feel up to the task of helping young children to build the foundation for later math learning in elementary school and beyond, by providing math-related language and experiences in early childhood. "I've never been good at math," we say. "How can I help young children build a good foundation for math when my own foundation is so shaky? I don't even like to think about math."

Math avoidance can be difficult to overcome. But **when we avoid math-related thoughts, we often fail to recognize and capitalize on the math-related opportunities that occur in our lives and the lives of children throughout the day.**

Remember, **math for young children** is more than numbers and arithmetic. It **involves logical operations that we perform many times a day** at work, at home, and in the community, without ever really noticing that we are "doing math." We count children on the playground, places at the table, or pieces of equipment in the classroom. We sort and match—the right person for the right assignment at work, or the right colors and fabrics to decorate our homes. We describe how two family members or friends are alike and how they are different. When we drive, we estimate distance and calculate how long it will take to get somewhere. Even if we rely on maps and dashboard computers, our understanding of the information they offer means we have relied on our ability to "do math." Remembering that math is an everyday part of our own lives allows us to put aside our fears so we can plan and provide strategies to support children's emerging skills in understanding math concepts.

Recognizing and capitalizing on math opportunities throughout the day **requires planning, systematic thought, and a willingness to enter your children's world on their terms and with their points of view in mind.** As you develop successful strategies to support their emerging skills in classification, seriation, number, and other areas, **focus on the active learning environment, the daily routine, and good teacher-child interaction. As part of the daily routine's plan-do-review process,** allow children to **make choices** about what they will do, to **carry out their ideas,** and then to **reflect on their activities** with adults and peers. And make sure that the blocks of time in the daily routine are long enough for children to play uninterrupted.

High/Scope's math-related key experiences for early childhood

High/Scope has identified **13 math-related key experiences** for early childhood—seven in ***classification,*** three in ***seriation,*** and three in ***number.***

Classification, the process of **grouping things together according to common attributes or characteristics,** is one way in which children organize the people, materials, and events in their lives. Classification experiences help prepare children for such mathematical topics as sets, part-whole relationships, multiplication, and division.

Seriation (to remember this one, think "series") is the **ordering of things based on differences and gradual variations in their quality.** Classification is finding order in similarities; seriation is finding order in differences. In seriation, children logically arrange a series of objects based on *variation* in a single attribute (for example, arranging blocks from largest to smallest) or a *repeating sequence* of attributes (for example, red bead, blue bead, red bead, blue bead). Older preschoolers may match one ordered series to another, for example, by placing small, medium, and large tea cups on small, medium, and large saucers, respectively. Seriation experiences with real objects in early childhood are an important foundation for future math experiences that involve ordered differences, numeric patterns, and measurements.

Children learn about part whole relationships in a hands-on way.

The **concept of *number*** emerges as preschoolers sort materials into groups and collections. They see that counting involves equalities—toy cars all have four wheels and square blocks all have four sides. In this way, **number develops along with classification.** At the same time, preschoolers see that objects in a series are put in order according to certain distinctions. Cars, for example, may be lined up by size or by the order in which they finish a race—the first car to finish, the second car, and so on. In this respect, their **understanding of number develops in parallel with seriation.**

As they observe and join children at play, teachers and parents try to understand each child's unique and developing ability to reason and understand classification, seriation, and number, as well as other math concepts. We then adjust our support strategies to accommodate these emerging skills. We also recognize the importance of valuing and accepting children's explanations for their findings, even if some of them don't quite fit within adult standards.

In the following pages are descriptions and anecdotal examples of each math-related key experience and suggestions for supporting each one.

The key experiences in classification.

Key Experiences in Classification

Easy to observe in young preschoolers:

- ☆ Exploring and describing similarities, differences, and the attributes of things
- ☆ Distinguishing and describing shapes
- ☆ Sorting and matching
- ☆ Using and describing something in several ways

Beginning to emerge in older preschoolers:

- ☆ Holding more than one attribute in mind at a time
- ☆ Distinguishing between **some** and **all**
- ☆ Describing characteristics something does not possess or what class it does not belong to

Key Experience

★ Exploring and describing similarities, differences, and the attributes of things

Young children love to explore their environment and talk about their discoveries and experiences. A particular texture, sound, movement, or design grabs their attention, and they begin to wonder about what it is, where it came from, or how to repeat it. As they explore the attributes of an object or experience, they begin to understand in their own way what makes it similar to or different from other materials or events they have experienced.

Examples of children

Exploring and describing similarities, differences, and the attributes of things

- Dion fills a cup with paper and cloth pieces and tapes it closed. He shakes the cup: "It doesn't make a sound. It has only quiet things in it."
- While waiting in line for the bus, Dyani tells Luisa, "Look! We both have dresses and we are both girls."
- Aisha makes purple and green "play dough snakes." She places them in pie tins and tells Mr. Roberts, "I have long purple ones and long green ones."

Cooking together lets children explore the attributes of many foods.

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Ways to support children in exploring and describing similarities, differences, and the attributes of things

Provide and label interesting materials.

Stock interest areas with abundant and diverse materials that reflect and extend children's home and cultural experiences. **Include materials that children can use to explore similarities and differences** in color, size, shape, length, weight, texture, temperature, speed, and other qualities. **Arrange materials in ways that foster conceptual development.** For example, store blocks by shape in the construction area and arrange pots by size in the house area. Label storage containers and keep them in an easily reached location so that children may retrieve and replace materials without help. A list of suggested materials is provided on p. 45.

Support children as they collect things.

- ***Make time for collecting.*** Give children enough time to examine and collect things that attract their attention on the playground, on walks, or in the classroom. On field trips, don't be surprised to find that stopping to look at things along the way is nearly as interesting and exciting as arriving at the destination.

- ***Listen for children's comments and descriptions.*** Listen thoughtfully to what children say and extend the experience by asking occasional open-ended questions about their collections:

Children like to talk about what they've discovered.

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"Look at these squirrel nuts," Miguel says as he holds up a fist full of acorns. "Yes, those are nuts squirrels eat," his teacher, Lorenzo, replies. "I wonder where they came from?"

No matter how ordinary a collected item might be to you, these collected "treasures" fascinate children and are very likely to be what they talk about and describe during small-group time and at recall time.

Accept the descriptive names children use for objects.

Accept children's descriptive names for objects and their attributes, for these names are windows into children's thinking. For example, packing pieces made of Styrofoam are often used in artwork and pretend play in the early childhood classroom. Some children call them "popcorns," focusing on their structural resemblance to a favorite food. Others call them "white squishes," apparently in reference to their color and texture.

Encourage children to make labels for new materials.

Ask children to make labels for the things they collect and the new materials you bring to the classroom. This gives them a natural opportunity to focus on an item's specific attributes. Some children might draw a picture label representing the object; another child might tape one of the objects to the outer side of the storage container for easy identification. Others might dictate words for you to write on a label.

As children solve problems, listen for their references to attributes, similarities, and differences.

Listen to children's problem solving. You will often gain another perspective on their understanding of the attributes of the things they are using. Here's an example:

Kacey and Trey are both playing with the plastic dinosaurs. Kacey wants the large triceratops Trey is playing with. "Trey," she says, "I need that one with the three horns because I have the baby one [with the three horns] and it needs its mommy." Trey pauses to consider Kacey's request. Kacey continues, "If you give me the mommy, you can have all the yellow ones." "Okay," Trey agrees, handing over the triceratops and gathering up all the yellow dinosaurs.

Key Experience

★ Distinguishing and describing shapes

Shape is one of many physical attributes that interest children as they play. They stack and balance regularly shaped blocks as they build towers, spaceships, and houses. They generate regular and irregular shapes—sometimes purposefully and sometimes by accident—as they paint, glue, shape, and arrange things in the art area. And they enjoy picking out shapes in all the activities around them: finding a *square* in a work of art, sitting with a group in a *circle*, or striking a *triangle* during music time.

Examples of children

Distinguishing and describing shapes

- Observing his teacher's polka-dot blouse, Dhara says, "Hey! Your shirt has circles on it."
- Nita picks up a three-sided piece of Styrofoam in the art area and hits it with a pencil. "Ding, ding, ding! I made a triangle!" she says.
- As Luke puts away the wooden blocks, he places the large green rectangles in one box and the small green squares in another.

Cardboard rectangles, circles, and squares make great building blocks.

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Ways to support children in distinguishing and describing shapes

- ***Provide a variety of regularly shaped materials.***

Regularly shaped materials in play areas encourage children to recognize geometric shapes like triangles, squares, and rectangles. This is especially true in the block area, where children build with unit blocks, packing boxes, and cardboard blocks, and in the art area, where they use regularly shaped pieces of Styrofoam, wood, paper, and cardboard to create collages of geometric shapes. A list of additional materials is provided on p. 45.

- ***Watch for shape-making play.***

Children often generate their own shapes as they play—during movement and dance games; when drawing, painting, making a collage, or playing with clay and play dough; while playing with sand, coloring with chalk on outdoor blacktop surfaces, or working with wood at a workbench. Observing children closely during these kinds of activities will often tell you something about their understanding of and interest in shapes.

- ***Listen for talk about shapes.***

Keep in mind that children's thought processes and willingness to share their discoveries are much more important at this age than the accuracy of their conclusions, which will improve with time and experience. Extend children's learning by providing names and labels for things, asking them open-ended questions, engaging them in meaningful conversations, and challenging their thinking.

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Key Experience

☆ Sorting and matching

Young children sort and match materials to fulfill their own purposes. Before they ever arrive in your classroom, they may have sorted through a pile of socks to find a matched pair, or picked out a shirt that matches the color of their pants. In the classroom, they create their own ways of grouping things as they sort through pegs, blocks, bears, or dollhouse people to find just the ones they want to use during work time. When it's time to go home, they visually sort through a group of waiting parents and match parents to children as they look for their own.

Examples of children
Sorting and matching

- As he plays grocery store with his friends, Antoine tells one group to stand by the table because they have "a lot of food" in their baskets and tells another group to stand by the chair because they have "only five" items.
- Raven sorts out the red and blue snap-together blocks, then builds a boat with blue blocks on one side and red blocks on the other.
- Liu sorts through all the felt-tipped markers until she finds one that matches the color of her shirt.

Different types of dry beans and pasta encourage sorting and matching

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Ways to support children in sorting and matching

Provide materials for sorting and matching.

Fill each interest area with sets of purchased toys (cars, trucks, blocks, and so on); dry food items like nuts, macaroni, and cereal; art supplies like crayons and felt-tipped markers; household items like dishes and pots; collections of things gathered from home, outside, or on field trips; and computers with appropriate software programs for sorting and matching. (See p. 45 for more ideas.)

Consider times for choosing and storing toys as ongoing opportunities for children to sort and match materials.

As children carry out their plans, they gather materials they need, use them according to their own purposes, and then return them to their labeled storage places.

The containers and shelving you choose for storing toys and other materials will encourage specific kinds of sorting. Divided storage containers involve children in sorting by size, shape, or color. Baskets and undivided containers encourage separating things into large groups—all colors of crayons together in one basket, all colors of markers in another.

Allowing children to decide where to store new materials will offer another opportunity for them to think about sorting and matching and make decisions based on similarities and differences.

Watch for and acknowledge children's spontaneous sorting and matching.

When children finish what they are doing or pause to look at their work in progress, adults can often converse with them about the sorting and matching decisions they are making. Use these opportunities to observe what characteristics attract children so you can offer more materials and activities that have those attributes.

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- ***Ask children to make things that are the same and things that are different.***

  Try providing children with individual sets of art or building materials, such as blocks, clay, pipe cleaners and wire, or collage materials. Ask them to make two or three things that are the same. Ask them to make things that are different. Watch closely to see what they do. Although some children will choose to do something else with the materials, others will make essentially similar figures, or figures that share some attributes but differ in a significant way. Comment on the similarities and differences in their creations.

Choose storage containers and shelving that encourage sorting.

Key Experience

☆ Using and describing something in several ways

In an active learning setting, children find that almost any object can be used in a number of different ways. Large square blocks can become chairs, small rectangular blocks can be used as flashlights and telescopes, and square scarves can become capes, baby blankets, or bandages.

This math-related key experience, *using and describing something in several ways,* is similar to the creative representation key experience *pretending and role playing.* In both experiences, children use materials in different ways, but the focus of their play and the things they learn in each experience are different.

Examples of children

Using and describing something in several ways

- When Anna and Jessa play "bees," they use blocks to build the walls of their "hive" and also to represent "stingers" and "honey cakes."
- Kendrick holds a long rectangular wooden block up to his eye and says, "I can see a gabillion stars!"
- At small-group time, Lainie and Athi talk about the pine cones they are using: "Look, my pine cone rolls!" says Lainie. "Mine stands up!" answers Athi.

When children's interests are centered on imaginary play (Creative Representation: *Pretending and role playing),* the **story they are creating is the focus of their play and learning. The materials they use are more or less props** needed to advance their story, even though they may have been chosen precisely because of their interesting and useful attributes.

When children's interests are centered on the attributes of blocks and scarves and the other things they are playing with (Classification: *Using and describing something in several ways),* the **materials themselves become the focus of their play and learning.** The accompanying imaginary play is more a secondary interest than a primary one.

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Ways to support children in using and describing something in several ways

- ***Be aware of the various ways in which children use materials.***

• ***Observe and acknowledge children's use of materials.*** Through trial and error, children discover new ways to use materials in order to solve problems that slow down their play. For example, a white glove can serve as a "bandage" for a doll's broken leg, two small blocks can fill in a space if there are no large blocks left, and long scarves can become dog leashes.

As you acknowledge the ways in which children use materials, extend the language they use to describe something. For example, Lainie's comment about the pine cone rolling could be extended with "Yes, your pine cone rolls all wobbly, like a football!"

• ***Refer one child to another.*** Extend children's learning about how materials can be used by drawing their attention to what other children are doing:

Anna and Jessa tape "bee messages" to blocks and tape the blocks to their feet so they won't get "stuck to the honey." Meanwhile, Deola makes a pair of paper shoes at the computer, cuts them out, and then cannot figure out a way to keep them on her feet. Her teacher, Beth, suggests, "Maybe you could talk to Anna and Jessa about how they kept their bee shoes on their feet."

- ***Support children's use of materials in problem solving.***

Your support strengthens not only children's sense of initiative and feelings of competence but also their understanding of attributes and how things work:

> *Marcus is building a mouse house but needs more wooden blocks. "Carmen," he says to his teacher, "I need more blocks!" "You sure do," Carmen agrees. "But," Marcus says, "everybody's using 'em!" "Well, that's true," Carmen agrees. "I wonder if there is something else you could use instead." Marcus looks around and spots cardboard boxes he and his friends had used earlier in the week to make a "ride-in" train. He chooses two of the boxes to complete his mouse house.*

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Key Experience

☆ Holding more than one attribute in mind at a time

As young children develop the capacity to hold more than one attribute in mind at a time, they move from their usual "either/or" thinking and focus briefly, but at the same time, on two attributes of an object or experience that is personally meaningful. As the day goes on, they switch back and forth between these two types of thinking.

Examples of children

Holding more than one attribute in mind at a time

- "My car is faster and more shinier than yours," says Dakota.
- Brian sorts a group of colored magnetic shapes of various sizes on the magnet board. He makes one grouping and says, "These are all the biggest shapes, and they're all blue!"
- "This horse is big!" says Amir as he visits the horse farm with his class. "And this one is big and orange, like my brother's basketball."

The collie's fur is long and soft.

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Ways to support children in holding more than one attribute in mind at a time

Listen for children's references to more than one attribute at a time.

Don't be surprised if children mention two attributes or characteristics of something, but then pay attention to just one:

> *In the block area one day, Amanda points out a block she has used for a "special" chair. "It's square and it's blue," she tells Rose, one of her teachers. When Amanda adds other "special chair" blocks, some are*

Puzzle pieces are matched by color and shape.

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square and blue like the first [two attributes], some are square but not blue, and some are blue but not square.

Play dough is cool and smooth.

Provide storage containers that encourage children to sort a set of materials according to two attributes.

For example, if you have blue and green toy dinosaurs in large and small sizes, try storing them in containers that divide the materials according to size and color. Store large blue dinosaurs in one container, small blue dinosaurs in a second container, large green dinosaurs in a third container, and small green dinosaurs in a fourth.

Some children will sort the dinosaurs according to size and color (two attributes) and place them into their respective containers. Other children will sort the dinosaurs by color only (one attribute), mixing large and small green dinosaurs in one or both of the green dinosaur containers. Still others will sort the dinosaurs by size only (one attribute), mixing small green and small blue dinosaurs into one of the two small dinosaur containers.

Appreciate the complexity of children's guessing games and riddles.

Guessing games and riddles require children to hold more than one mental image in mind. Support those who are able to do this by challenging them with increasingly complex verbal puzzles and games. Ask them to give you clues about the mental images they are thinking about: Is it a plant? Is it an animal? Can you wear it? Can you eat it? Does it fly? Does it swim? Can you ride on it? Some children will enjoy more and more complex questions and provide appropriate clues. Others will become impatient and quickly blurt out the answer so they can go on to a new riddle or guessing game or some other activity.

Key Experience

☆ Distinguishing between *some* and *all*

When young children begin to see the relationship between parts of a set (some of the blocks) and the whole set (all of the blocks), they begin to use the terms *some* and *all* appropriately. *All* generally stands for "all [the blocks] I can see" while *some* generally indicates "the ones I want or need."

Examples of children

Distinguishing between *some* and *all*

- "They don't all fit," says Kyesha, as she tries to pour all of the beads into the coffeepot. "But some of them do."
- At snack time, James pours juice to the top of her glass. "Hey!" says Enriqua. "You can't have all of it! You've got to leave some."
- "I'll just take some of the crayons," DuShawn tells Matthew. "Then you can have all the rest."

"Let's use all the blocks!"

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Ways to support children in distinguishing between some and all

- ***Store similar materials together.***

  For example, when all of the markers and crayons are stored in separate containers next to each other, children planning to make drawings can stand in front of the two collections of drawing materials and choose some of every color (just markers, just crayons, or a mixture of both) or all of just one color (markers or crayons). Storing like materials together allows children to complete their planning in a timely way and move on.

- ***Listen for children's use of the words* some *and* all.**

  You'll hear children use these words at almost any time of the day—during snack time ("You can't have all of the juice. I want some."); as they gather their materials ("I know. You let me have some of the blocks for a little while, and then you can have all of them."); and as they return materials to their storage place ("Let's just pick up some of the crayons.").

"We're having some sprinkly cupcakes for snack!"

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Key Experience

☆ Describing characteristics something does not possess or what class it does not belong to

Dealing with **absent attributes** ("It doesn't have any wheels!") and **groups something does not belong to** ("All the kids with hoods stand up! All the kids with no hoods sit down!") calls upon two developing capacities in young children: forming mental images and thinking about two things at once. These are **very complex thought processes** for preschoolers.

In the example below, Corey's statement shows that he has pictured in his mind a truck with wheels and compared it to the truck whose wheels are missing. To sort children into the "no-hoods" group, Chelsea has had to pick out an attribute that some children's clothing has (a hood) and then mentally place all the remaining children in the group without hoods.

Examples of children

Describing characteristics something does not possess or what class it does not belong to

- "I don't want that truck. It doesn't have any wheels," Corey says.
- Chelsea says to the children using the tire swing, "All the kids with hoods stand up! All the kids with no hoods sit down!"
- On the playground, Carlos notices a dog in the yard across the street. "That looks like a German shepherd dog like the one I have at home. But his tail's too short, so I guess he's not."

"I'm only looking for red squares, not those."

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Ways to support children in describing characteristics something does not possess or what class it does not belong to

***Watch and listen for children's everyday use of* not.**

Use of this word is an indication that children are able to form a mental image of a particular thing and decide whether other things match it or not:

- Corrine decides to bathe the baby dolls, but she realizes that some dolls are not suitable for getting wet. So, she puts all the "washing babies" on the table and all the "not-for-washing babies" in the bed.
- Juanita makes two wooden sculptures at work time. She puts a work-in-progress sign on one of them. [A work-in-progress sign is used in the classroom to indicate a project is not finished. The sign has "work-in-progress" spelled out and includes a drawing of a hand enclosed in a circle with a line through it.] Juanita does not put a sign on the other sculpture. When her teacher Rosie asks her about it, Juanita replies, "This is a do-not-touch one because I'm going to finish it tomorrow. That one is done so you can touch it."

"That's not a sheep! It looks like a little lamb."

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The key experiences in seriation

As we mentioned earlier, young children organize and make sense of their world not only by grouping things according to their similarities (classification) but also by arranging things in series and patterns according to their differences and gradual variations (seriation). You can support learning in seriation by providing materials with serial qualities and storing them in labeled containers easily reached by children. A list of suggested materials is provided on pp. 45–46.

Key Experiences in Seriation

- ☆ Comparing attributes (longer/shorter, bigger/smaller)
- ☆ Arranging several things one after another in a series or pattern and describing the relationships (big/bigger/biggest, red/blue/red/blue)
- ☆ Fitting one ordered set of objects to another through trial and error (small cup—small saucer/medium cup—medium saucer/big cup—big saucer)

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Key Experience

☆ Comparing attributes (longer/shorter, bigger/smaller)

Because of their small stature compared to most other people and things, young children spend a lot of time thinking about attributes like *longer/shorter* and *bigger/smaller*. Perhaps this helps them understand their own position relative to the rest of the world—taller and heavier than a few things, but shorter and lighter than most others. They also gradually learn that as they grow, their relative position in the world changes—"I used to be shorter than the playground fence, but now I am the same."

Examples of children

Comparing attributes (longer/shorter, bigger/smaller)

- "My new baby brother is very, very little," Aaron announces to his teacher one morning. "I'm very big."
- "Can you make your snake even longer?" Hannah asks Jamal, who is rolling a piece of play dough.
- "Watch, Mrs. T.," Jeffery says while pushing cars down a slanted block. "This one is slow, and this red one is fast."

Plastic farm animals in two sizes encourage children to compare attributes.

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Ways to support children in comparing attributes (longer/shorter, bigger/smaller)

Provide materials whose attributes children can easily compare.

- ***Sets of materials in two sizes.*** The list of materials you can find in two different sizes is almost unlimited. Toy stores, recycling centers, resale shops, and your own home are good places to begin your search. Look for sizes that are obviously different (large, medium, small) as well as sizes that are less distinct (small, smaller, smallest). Remember to also look for sets that come in more than two sizes.
- ***Materials children can shape and change.*** Provide pliable materials that children can use to make their own creations in different sizes—clay, baking dough (bread, cookie, or pizza), play dough, modeling beeswax, damp sand, pipe cleaners, and drawing and painting materials.
- ***Materials with other contrasting attributes.*** Stock materials that have contrasting attributes, such as rough and smooth stones; curly and straight macaroni; dark-, medium-, and light-colored crayons; and musical instruments that children can play at different levels of loudness or different speeds.

Store and label materials in a way that encourages children to compare attributes.

Separate large, medium, and small materials into different containers and store them side by side. Consider using larger containers for the larger items, medium containers for the medium items, and smaller containers for the small items to reinforce the idea of large, medium, and small.

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Listen for and support the comparisons children make as they play and solve problems.

Sometimes you will observe children solving a problem during play because they were able to compare attributes and recognize differences and variations. For example, they may realize that the last block they have carefully balanced on a tower of blocks has made the tower so **high** that they cannot reach the top. They may solve their problem by recognizing that standing on a sturdy chair will make them **higher** than the tower.

I wonder how I'm going to put more blocks on top?

Key Experience

☆ Arranging several things one after another in a series or pattern and describing the relationships (big/bigger/biggest, red/blue/red/blue)

As young children begin to arrange things in a series by size, they often refer to the "daddy" one, the "mommy" one, and the "baby" one. Later, they begin to use terms like *large, medium,* and *small,* or *long, longer,* and *longest.*

Although young children often create series that include three or four elements (small, medium, large), when creating patterns they generally alternate just two elements, such as red beads and blue beads.

Examples of children

Arranging several things one after another in a series or pattern and describing the relationships (big/bigger/biggest, red/blue/red/blue)

- While playing in the house area, Sarah arranges three baby bottles on the shelf in order from smallest to largest.
- Jackson watches Tierra place plastic fruit on the table: red apple, green grapes, red strawberry, and green lime. He adds another red apple to the line of fruit.
- While eating snack outside, Denise points out a pattern in the tablecloth and says, "Red, white, red, white."

Boxes in several sizes encourage seriation experiences.

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Ways to support children in arranging several things one after another in a series or pattern and describing the relationships (big/bigger/biggest, red/blue/red/blue)

Provide collections and sets of materials.

- ***Sets of materials in three or four sizes.*** Provide materials that are the same or similar except for their size. Look for materials that nest—measuring cups, measuring spoons, funnels, food storage containers—and other things that can be lined up according to graduated sizes—socket wrenches, drill bits, rubber bands. A list of suggested materials is provided on pp. 45–46.
- ***Materials that children can use to make their own series and patterns.*** When offered appropriate materials, young children are often inspired to create their own series and patterns, such as clay figures in graduated sizes representing their families—grandparents, parents, children, and even pets—or a sky patterned with stars of several sizes.
- ***Computer software programs that feature series and patterns.*** Software programs that allow young children to create their own series and patterns are available. For descriptions of such programs, see the bi-monthly magazine *Children's Software Revue* (www.childrenssoftware.com).

Watch and listen for talk about the series and patterns children make.

Sometimes children signal their awareness of series and patterns as they talk about what they are doing: "This is how my dad works on our car," says Roberto as he lines up four socket wrenches in order of size. At other times, children may create a series or pattern without describing it: "Look at my rainbows," Leah says, holding up a painting of two identical patterns of color.

Ask children to draw or make things that involve series and patterns, such as making representations of their family members from clay.

Offer children clay, play dough, and drawing and painting materials and ask them to make their families. Or give them pegs and pegboards and watch to see if anyone makes and/or recognizes a pattern.

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Read stories and encourage children to represent stories in which size relationships and other graduated qualities play an important role.

The main themes of many books for young children center around size relationships. *Goldilocks and the Three Bears* and *The Three Billy Goats Gruff* are familiar examples.

After children have heard one of these stories several times, plan a series of retelling and re-enactment activities during small-group time and see how they deal with size relationships and other graduated qualities. Let them retell the story in their own way through drawing, painting, or playing with clay, play dough, and pipe cleaners and blocks.

Encourage a re-enactment activity that uses musical instruments with various pitches—low-pitched for the papa bear on up to high-pitched for the baby bear.

For your book area, choose some books that focus on size relationships.

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Key Experience

☆ Fitting one ordered set of objects to another through trial and error (small cup—small saucer/medium cup—medium saucer/big cup—big saucer)

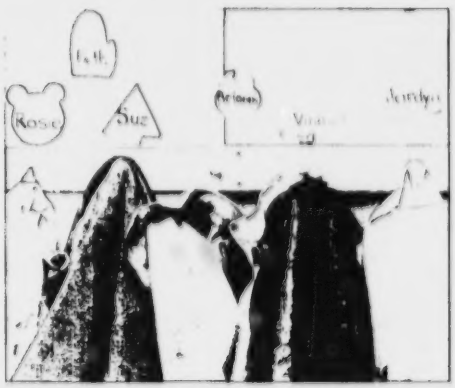
In the course of their play, children become very engrossed in matching two ordered sets of things, for example, matching small, medium, and large bowls with their corresponding lids. This is often done by trial and error and in response to a need:

During their beauty shop play, Joanie and Lynnette are very intent on sorting and matching the three sizes of rollers and roller clips for the "sets" and "perms" they are giving their dolls.

Examples of children

Fitting one ordered set of objects to another through trial and error (small cup-small saucer/medium cup-medium saucer/big cup-big saucer)

- At cleanup time, Alana matches three measuring cups of different sizes to the outlines drawn on the pegboard and hangs them up.
- Tanya "walks" a family of toy lions around in a circle and then uses cloths to cover each of them up—small cloth for the baby, medium cloth for the mother, and large cloth for the father.
- As Anu sets the table for "tea," he places the small cup on the small saucer, the medium cup on the medium saucer, and the large cup on the large saucer, then calls out, "Time for tea!"



Children match their backpacks to hooks under their names.

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Ways to support children in fitting one ordered set of objects to another through trial and error (small cup—small saucer/medium cup—medium saucer/big cup—big saucer)

Provide ordered sets of materials that go together and watch to see how children use them.

Many common household items are perfect materials for encouraging children to match sets—flower pots and saucers, coffee cans and lids, squeeze bottles and tops, and boxes and covers, to name a few. A list of additional materials is provided on pp. 45–46.

Metal canisters with matching lids encourage seriation.

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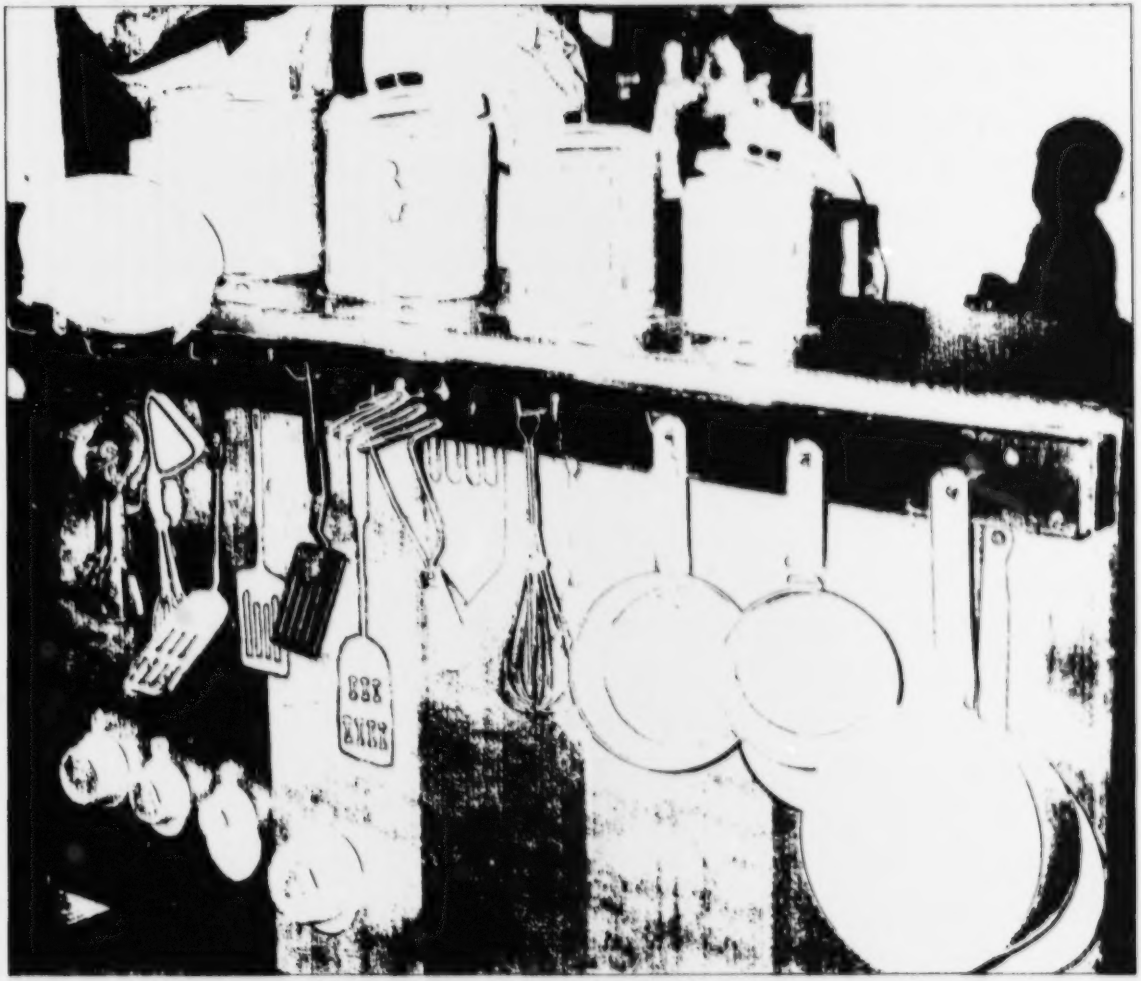

Shapes drawn under hooks help children store ordered sets of kitchen tools in the right place.

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The key experiences in number.

Young children's understanding of number develops along with their emerging understanding of the concept of one-to-one-correspondence, the idea that certain sets of things go together. By physically matching a set of four toy cars with a set of four toy people, for example, they begin to see that the number of cars and the number of people are the same, and there is nothing left over.

Number also develops along with the understanding that the number or amount of something remains the same, regardless of its shape or arrangement in space. This concept is hard for young children to grasp. When comparing a certain number of a large-sized item with the same number of a small-sized item, young children will almost always think that there are more large-sized items. For example, a line of four Frisbees will seem like more than a line of four marbles. When comparing small quantities like marbles and small metal cars, however, they rely more on actual counting and matching.

Key Experiences in Number

- ☆ Comparing the number of things in two sets to determine **more, fewer,** or **same number**
- ☆ Arranging two sets of objects in one-to-one correspondence
- ☆ Counting objects

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Key Experience

☆ Comparing the number of things in two sets to determine *more, fewer, same number*

Some young children are more accurate in their determination of *more, fewer,* and *same number* than others are, depending on the level of their development. That is why we meet all children where they are and support them with the materials, experiences, and adult-child interaction that will help their comparison skills grow at their own pace.

Examples of children

Comparing the number of things in two sets to determine *more, fewer, same number*

- "My baby sister just got a new tooth," Miesha announces to her teacher one morning. "But I still have lots more than her."
- On a day when several children are absent, Sadie looks around the greeting circle and says, "There are not much kids here."
- "We've got the same number of brothers—one," Sanjay tells Rebecca as they look at picture albums of their families.

I wonder how many more this truck will hold?

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Ways to support children in comparing the number of things in two sets to determine more, fewer, same number

Provide materials for comparing numbers of things.

Well-stocked preschools have materials that children compare and count spontaneously as they play. Include sets or collections of countable materials such as beads, blocks, cars, and dolls—sets you provide as well as children's own collections. Keep a well-stocked art area for children who enjoy counting and comparing their clay creations, pieces in their collage, or shapes in their paintings. A list of suggested materials is provided on p. 46.

Listen for children's spontaneous number comparisons.

When children's natural curiosity leads to math-related comments, problems, and questions during play, interact with them thoughtfully. Using number words and ideas when you talk with children throughout the day will help them clarify and add to their growing vocabulary of words describing relationships of number and comparison. Adding numbers to your conversations will help children begin to think of numbers as a useful way to describe what they are doing.

- ***Comparing numbers of materials.*** If you hear comments like "You have more blocks than Tyrell" or "You have six cars, same as me," you know that children are learning how to compare numbers of things.

These boys are deciding if they have the same number of toys.

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- ***Comparing numbers of things in representations.*** Children often compare the numbers of things in paintings and drawings they have made, as well as pictures in magazines and books—"This picture only has one sunflower. My picture has more, about ten."

"I'm almost four and you're just three and a half."

- ***Comparing ages.*** Most young children know how old they are and enjoy comparing their ages to those of other children, even if their understanding of comparison is still growing. For example, Becky was the last child in her class to turn five. On her fifth birthday, she said "Goody! Now I'm finally the oldest in my class!" Although Becky missed the idea that she would always be the youngest on the age continuum in her class, she nevertheless demonstrated her knowledge that five was more than four.

Accept children's findings about number.

When young children reach a mathematical conclusion, it is the result of using their best logic, even when those conclusions are incorrect by adult standards. Only by making her own observations and drawing her own conclusions can Becky, in the example above, build the base for the logical thinking she will need later.

Key Experience

☆ Arranging two sets of objects in one-to-one correspondence

As young children pair up sets of things while they play, they gain physical experience with equivalences, the idea that one "ice cream cone" for each child means there are the same number of cones and children. One-to-one matching experiences are fun for children and prepare them for counting experiences. As they match one-to-one, they begin to understand that every number—for example, 2, 5, or 9—has its own number matching word—in this case, two, five, and nine.

Examples of children

Arranging two sets of objects in one-to-one correspondence

- Using an ice-cube tray for a boat, Kioko puts one small bear in each "seat."
- Shakira counts out 13 plastic circles for "beds," then places one small kitty on each "bed."
- Douglas paints three hearts at the easel, then paints one line below each heart.

This girl finds that seven crackers and seven cubes of cheese match up one-to-one.

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Ways to support children in arranging two sets of objects in one-to-one correspondence

- ***Provide materials that fit together in one-to-one correspondence.*** Children will use almost anything available to create their own meaningful matched sets, so a well-stocked classroom will offer plenty of spontaneous one-to-one correspondence opportunities. In addition to all the materials children match up on their own, consider adding sets of things that are designed to fit together in one-to-one correspondence, such as pegs and pegboards, jars and lids, and egg cartons with plastic eggs. See p. 46 for more ideas.

- ***Watch for the sets of corresponding materials children generate.*** Children will arrange two sets of objects in one-to-one correspondence during the course of their play throughout the day, often in response to a need. For example, four "spacemen" may decide they need "walkie-talkies" in order to communicate in "space." Since blocks are the right shape and readily available, four rectangular wooden blocks become the needed tools.

  - ***Encourage children to share and talk about their one-to-one arrangements at recall time.*** Children may be reluctant to stop their play and talk to you about the one-to-one arrangements they have made, but with a little encouragement at recall time, they may be willing and able to show what they did. If you have an instant camera handy, take pictures of children's spontaneous matched sets and ask them to describe what they did. Or ask them to bring the materials they used to the recall table and re-create their matched sets.

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Encourage children to gather and distribute materials at snack and meal times, at small- and large-group times, and during card games.

Setting a table for snacks or meals offers a number of opportunities to arrange two or more sets in one-to-one correspondence. Set up a turn-taking chart so each child has the chance to gather and distribute cups, napkins, spoons, and plates for each person at the table.

Handing out scissors, glue sticks, and other materials during group time—one per person—is another opportunity for children to arrange sets in one-to-one correspondence.

Playing simple card games (such as *Go Fish* and *Memory*) with you and other children is a natural and fun way for children to match sets in one-to-one correspondence. The child who deals the cards must give each player an equal number of cards, which is not an easy task for a young child. Try not to correct the process; children will help one another figure it out.

Children arrange blocks in one-to-one correspondence.

Key Experience

☆ Counting objects

Children count people, toys, cars, animals, leaves, and just about anything else they see, not always correctly, but often with a sense of great joy and personal satisfaction, because children love to count.

Examples of children Counting objects

- "I'm one, two, three, four," Diego says as he holds up another finger with each number he counts.
- Kira counts out seven goldfish when she serves herself a snack.
- Working with the magnet board, Miranda counts 13 letters and says, "Look, I have thirteen on the board."

Using number words and ideas during games and throughout the day adds to children's growing vocabulary of math words.

Ways to support children in counting objects

Provide sets of countable objects.

You can support their love of counting by offering young children a wide variety of countable materials, including collections of small things, board games, age-appropriate computer software programs that call for counting, and materials with numerals (a typewriter, a calculator, number stamps, and so on). A list of more suggested materials is on p. 46.

Listen for children counting and using number-related talk throughout the day and accept their numerical ordering.

It's common for young children to reverse order (from 13 to 19 to 16, and so on) and skip numbers as they count, especially when they begin to count into the two-digit range. Resist correcting children when this happens and appreciate the fact that they are beginning to understand the ascending and descending order of numbers. Their understanding of correct sequence and how many numbers exist will come later.

Watch for children's recognition of written numbers and support children who are interested in writing numbers.

The ability to recognize written numbers and the desire to write them are important developmental steps for young children. While drawing in the art area, a child may recognize a number within the picture or design they have drawn, perhaps a window that looks like the number six or a chair that looks like the number two. While playing with clay, another child might accidentally or deliberately make the number nine. Support these children in the same way you support them when they recognize letters or words or write them in their own way: Ask if they would like to share their discovery at recall time, suggest that they take the picture or clay shape home to show their parents, and help them draw numbers if they request your help.

A summary checklist of what to do to encourage math learning is provided on the next two pages. The checklist is followed by a list of recommended materials.

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Classification, Seriation, *and* Number
Key Experiences CHECKLIST: WHAT TO DO

Classification

☆ **Exploring and describing similarities, differences, and the attributes of things**

___ Provide and label interesting materials.
___ Support children as they collect things.
- Make time for collecting.
- Listen for children's comments and descriptions.

___ Accept the descriptive names children use for objects.
___ Encourage children to make labels for new materials.
___ As children solve problems, listen for their references to attributes, similarities, and differences.

☆ **Distinguishing and describing shapes**

___ Provide a variety of regularly shaped materials.
___ Watch for shape-making play.
___ Listen for talk about shapes.

☆ **Sorting and matching**

___ Provide materials for sorting and matching.
___ Consider times for choosing and storing toys as ongoing opportunities for children to sort and match materials.
___ Watch for and acknowledge children's spontaneous sorting and matching.
___ Ask children to make things that are the same and things that are different.

☆ **Using and describing something in several ways**

___ Be aware of the various ways in which children use materials.
- Observe and acknowledge children's use of materials.
- Refer one child to another.

___ Support children's use of materials in problem solving.

☆ **Holding more than one attribute in mind at a time**

___ Listen for children's references to more than one attribute at a time.
___ Provide storage containers that encourage children to sort a set of materials according to two attributes.
___ Appreciate the complexity of children's guessing games and riddles.

☆ **Distinguishing between *some* and *all***

___ Store similar materials together.
___ Listen for children's use of the words *some* and *all*.

☆ **Describing characteristics something does not possess or what class it does not belong to**

___ Watch and listen for children's everyday use of *not*.

Seriation

☆ **Comparing attributes (longer/shorter, bigger/smaller)**

___ Provide materials whose attributes children can easily compare.

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- Sets of materials in two sizes
- Materials children can shape and change
- Materials with other contrasting attributes

___ Store and label materials in a way that encourages children to compare attributes.

___ Listen for and support the comparisons children make as they play and solve problems.

☆ **Arranging several things one after another in a series or pattern and describing the relationships (big/bigger/biggest, red/blue/red/blue)**

___ Provide collections and sets of materials.
- Sets of materials in three or four sizes
- Materials that children can use to make their own series and patterns.
- Computer software programs that feature series and patterns.

___ Watch and listen for talk about the series and patterns children make.

___ Ask children to draw or make things that involve series and patterns, such as making representations of their family members from clay.

___ Read stories and encourage children to represent stories in which size relationships and other graduated qualities play an important role.

☆ **Fitting one ordered set of objects to another through trial and error (small cup—small saucer/medium cup—medium saucer/big cup—big saucer)**

___ Provide ordered sets of materials that go together and watch to see how children use them.

Number

☆ **Comparing the number of things in two sets to determine *more, fewer, same number***

___ Provide materials for comparing numbers of things.

___ Listen for children's spontaneous number comparisons.
- Comparing numbers of materials
- Comparing numbers of things in representations
- Comparing ages

___ Accept children's findings about number.

☆ **Arranging two sets of objects in one-to-one correspondence**

___ Provide materials that fit together in one-to-one correspondence.

___ Watch for the sets of corresponding materials children generate
- Encourage children to share and talk about their one-to-one arrangements at recall time.

___ Encourage children to gather and distribute materials at snack and meal times, at small- and large-group times, and during card games.

☆ **Counting objects**

___ Provide sets of countable objects.

___ Listen for children counting and using number-related talk throughout the day and accept their numerical ordering.

___ Watch for children's recognition of written numbers and support children who are interested in writing numbers.

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Materials for Classification, Seriation, and Number

Classification

Interesting materials children can investigate and talk about

Household and natural materials with attractive characteristics—shaving cream, baby oil, foil, sandpaper, wrapping paper, crepe paper, stones, nuts, shells

Materials with moving parts—tools, kitchen utensils, musical instruments, cameras

Materials that change—clay, play dough, computer drawing programs, sand, water, live animals and insects

Materials specifically related to children's immediate purpose—boxes for building forts, telephone books for playing office, nails for pounding

Regularly shaped materials

Squares, rectangles, triangles, circles—blocks, boxes, carpet pieces, plates, lids, food containers, cookie cutters, blankets, scarves, towels, rings, bracelets, buttons, beads, bottle caps, cards, books, dominoes, Tinkertoys, shape-sorter shapes, attribute blocks, Cuisenaire rods, pieces of wood, tambourines, triangles, wood blocks.

Regularly shaped collage materials in the art area—pieces of paper, cloth, sandpaper, cardboard, ribbon, netting, Styrofoam, balsa wood, foam rubber, all cut into circles, triangles, rectangles, and squares

Materials for sorting and matching

Sets of toys—blocks, Tinkertoys, cars, trucks, toy animals, dollhouse people

Classroom collections—nuts, stones, shells, pine cones, buttons, marbles, bottle caps, beads, pegs, collage materials, crayons, markers, food containers, silverware, dishes, scarves, ties, hats, gloves, cards, tools, musical instruments, and balls

Children's collections—things gathered from home, outside, or on field trips

Computers with appropriate software programs for sorting and matching. For a listing of such programs, see the bimonthly magazine *Children's Software Revue* (www.childrenssoftware.com).

Seriation

Sets of materials in two sizes—large and small dinosaurs, farm animals, trucks and cars, buttons, nails, shells, Tinkertoys, blocks, boxes, dolls, blankets, cookie cutters, paintbrushes, sponges, balls, buckets, cymbals, drums

Materials children can shape and change—pliable materials such as clay, baking dough (bread, cookie, or pizza), play dough, modeling beeswax, damp sand; blocks, clay, pipe cleaners, wire, collage materials

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Materials with other contrasting attributes—rough and smooth stones; curly and straight macaroni; dark-, medium-, and light-colored crayons; musical instruments that can be played at different levels of loudness or at different speeds

Materials that children can use to make their own series and patterns—blocks, clay, collage materials, paper, paints, crayons, markers, pencils, beads and sticks in different colors and sizes, counting cubes, rods

Sets of same or similar materials in three or four sizes—things that nest, such as measuring cups, nesting blocks, measuring spoons, stacking rings, funnels, food storage containers, mixing bowls, canisters, Cuisenaire rods; things that can be lined up according to graduated sizes, such as socket wrenches, drill bits, rubber bands; things that can be gathered or made, such as boxes, pillows, shells, buttons, and beanbags

Children's books that center around size relationships—for example, *Goldilocks and the Three Bears* and *The Three Billy Goats Gruff*

Ordered sets of materials that go together, in three or four sizes—flower pots and saucers, mixing bowls and lids, coffee cans and lids, cups and saucers, canisters and lids, squeeze bottles and tops, muffin papers and muffin tins, envelopes and cards, boxes and covers, nuts and bolts, dolls and doll clothes, doll beds and covers, LEGO blocks and LEGO people

Computers with appropriate software programs for sorting and matching. For a listing of such programs, see the bimonthly magazine *Children's Software Revue* (www.childrenssoftware.com).

Number

Materials for comparing numbers of things—sets or collections of countable materials such as beads, blocks, cars, dolls, buttons, and cans; children's own collections of rocks, shells, leaves, cards, bottle caps, and so on; a well-stocked art area so children can enjoy comparing the numbers of things in their own works of art

Materials that fit together in one-to-one correspondence—pegs and pegboards, jars and lids, egg cartons and plastic eggs, felt-tipped pens and tops, a Chinese checkers set

Sets of countable objects—blocks (unit, multicolored, hollow, snap-together); collections of small items (beads, bottle caps, pebbles, small shells, poker chips, chestnuts, buttons, popcorn, raisins, cereal, fish crackers); computer software with counting games; materials with numbers on them (calculators, playing cards, and wooden numbers to copy and trace); and simple board games that include dice or spinners (remember that rules are less important to young children than counting spaces as they move around the board)

High/Scope

PRESCHOOL

Key Experiences

Classification, Seriation, and Number

High/Scope's approach to early math education meets standards set by the National Council of Teachers of Mathematics and its joint statement with the NAEYC.

As young children explore their environment, they begin to notice relationships between similar things and to develop rules for treating things the same or differently, based on characteristics like color, size, shape, and texture. Understanding these relationships and rules is the beginning of math learning. Our job as teachers and parents is to provide young children with age-appropriate words, materials, and experiences so they are free to investigate size, quantity, categorization, patterns, and other math concepts on their own terms with our support and encouragement.

This booklet describes the 13 math-related key experiences grouped under ***classification, seriation,*** and ***number,*** experiences that include

- ☆ Describing how things are similar or different
- ☆ Sorting and matching
- ☆ Distinguishing between *some* and *all*
- ☆ Arranging objects in a series or pattern
- ☆ Counting

Lists of materials that promote math exploration are provided, as well as teaching strategies that will help you to recognize and make the most of math opportunities throughout the day. The booklet is also well illustrated with pictures and anecdotal examples of children participating in these math-related key experiences.

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